

**Analysis of
California Phase 3 RFG Standards**

submitted to

California Energy Commission

under

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by

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1.0 OVERVIEW

This document provides modeling results for the set of cases defined by the California Energy Commission to evaluate the cost of an MTBE Ban and California Phase 3 RFG standards. The cases evaluated include:

- Base cases in which MTBE is blended into California RFG.
- A series of “A” cases in which ethanol is blended in California RFG at 2.0 wt% oxygen.
- A series of “B” cases in which ethanol is blended in California RFG at 2.7 wt% oxygen.
- A series of “D” cases in which no oxygenates are blended in California RFG.
- A series of “E” cases to estimate the least cost combination of ethanol blending (at 2.7 wt% oxygen) and no oxygenate blending. These cases were developed to evaluate the effects of the Feinstein-Bilbray bill.

We also were asked to evaluate a series of “C” cases in which ethanol is blended in California RFG at 3.5 wt% oxygen. However, because of the adverse effect that higher oxygen levels has on NOx emissions, as calculated by the Phase 3 Predictive Model, these cases were infeasible, i.e., our refinery model could not produce a complying gasoline. Hence, we do not report any results for this series of cases.

2.0 TABLES AND EXHIBITS

Tables A through D provide information regarding the definition of each of the cases specified by CEC.

- **Table A** shows a summary of the modeling assumptions comprising each of the cases we modeled.
- **Table B** shows the properties of each of the “Reference Fuels” specified by CEC.
- **Table C** shows the “emission deltas” used in the various cases. (The emissions deltas serve as targets in the refinery modeling, i.e., we try to “produce” a gasoline with properties yielding emission deltas, as calculated by the Predictive Model, close to those specified in the various cases.)
- **Table D** shows the “Property Compliance Margins” used in the various cases. (Note that, in some cases, no property compliance margins were used. In those cases, large emission deltas were used.)

Exhibits 1 through 6 provide the results of our refinery modeling.

- **Exhibit 1** shows process unit utilization and operations.
- **Exhibit 2A** shows refinery inputs. (Exhibits 2B and C define the supply curves for various refinery inputs. Exhibit 2D calculates cost adjustments depending on the volume of purchases of various inputs.)
- **Exhibit 3** shows refined product outputs and sales of “rejected blendstocks.”
- **Exhibit 4** shows the properties of CARB, Arizona, and conventional gasoline and the delta emissions (% emissions) calculated using the Predictive Model (not the reduced form incorporated in ARMS).
- **Exhibit 5** shows the composition of CARB, Arizona, and conventional gasoline.
- **Exhibit 6** shows the estimated cost of California Phase 3 RFG Standards.
- **Exhibit 7** shows the estimated effects of the Feinstein-Bilbray bill.

3.0 CASE DESCRIPTION

A brief description of the various cases is provided the following sections.

3.1 Base Cases

- Base 98. Calibrated to 1998, using the Phase 2 Predictive Model *with observed property compliance margins and observed emissions deltas*.
- Base 1. Same as Base 98, but requires Arizona gasoline to comply with Federal Phase 2 RFG standards. This serves as the base case for calculating the costs associated with the MTBE ban and adoption of the Phase 3 Predictive Model (with different variants of reference fuels).
- Base 2. Same as Base 1 with the following exceptions: (1) uses the Phase 3 Predictive Model with Reference Fuel A; and (2) uses the emissions deltas specified in Version 13 of the Matrix (i.e., does not use compliance margins, but instead uses large emission deltas calculated by running the 1998 reported fuel recipe through the Phase 3 Predictive Model).

3.2 MTBE Ban Cases

We evaluated three sets of MTBE ban cases as indicated above, ie, A, B, and D sets corresponding to ethanol blending at 2.0 wt% oxygen, ethanol blending at 2.7 wt% oxygen, and no oxygenate blending. For each set we assessed four to five variants, as follows.

- Case 1. Uses (1) the Phase 3 Predictive Model with Reference Fuel A and (2) the same emissions deltas as specified for Base 2.
- Case 2. Uses (1) the Phase 3 Predictive Model with Reference Fuel B (ARB's proposed reference fuel) and (2) property compliance margins and emissions deltas specified by ARB.
- Case 3. Uses (1) the Phase 3 Predictive Model with Reference Fuel C (less stringent T50 and T90 specifications) and (2) property compliance margins and emissions deltas specified by ARB.
- Case 4. Uses (1) the Phase 3 Predictive Model with Reference Fuel D (Reference Fuel B with 7.0 psi RVP) and (2) property compliance margins and emissions deltas specified by ARB.
- Sup 1. Uses (1) the *Phase 2* Predictive Model and (2) property compliance margins and emissions deltas specified by ARB. This case was not specified by the CEC, but we included it to allow a comparison to results in our previous study for the CEC.

3.3 Feinstein-Bilbray Cases

We conducted a series of model runs (for three variants of the Predictive Model) in which the non-oxygenated share of the California RFG pool progressively increased. The results provide an estimate of the benefits to California refiners (and consumers) from the flexibility the Feinstein-Bilbray bill provides refiners in blending Phase 3 compliant RFG.

4.0 KEY MODELING ASSUMPTIONS

We used the refinery model and boundary conditions specified in the “long term” analysis in the previous study for the CEC of the effects of an MTBE ban, with the following exceptions.

- Ethanol supply curve. The price paid for ethanol (ex subsidy) is \$43.55/bbl as compared to \$28.98 (reflecting ESIA's recent updates of the ethanol supply function for CEC).

- Arizona and conventional gasoline. Arizona gasoline is ethanol-blended (at 2.0 and 2.7 wt%) and conventional gasoline contains no oxygen. In the previous study, MTBE and TAME were blended in Arizona and conventional gasoline (except in the national MTBE ban cases).
- Alkylate supply. We assumed that refiners would buy C7 alkylate, rather than mixed alkylate, because of the value to California refiners of blendstocks with low T50. We increased the price of purchased alkylate by 7¢/gal to account for (1) the potential effects of EPA's gasoline sulfur standard on the market price of alkylate and (2) costs that might be incurred to fractionate alkylate into light and heavy cuts.
- CARBOB supply. We increased the price of CARBOB by 2¢/gal (CARBOB was imported only in the no oxygenate cases).
- Desulfurization: We added fractionation and post-FCC treatment of naphthas produced from ultra-low sulfur FCC feeds. (We assumed OCTGAIN 125 would be used.) We assumed that alkylate, hydrocrackate, and reformate would have sulfur content of 2, 1, and 1 ppm, respectively, for Cases 2a, 3a, and 4a (those cases in which the reference fuel has a sulfur level of 20 ppm). We accounted for the cost of controlling the sulfur content of those blendstocks by (1) reducing "existing" alkylate capacity by 5% and (2) adding additional investment, capital charges, and operating costs in post-modeling spreadsheet processing.

The estimated per gallon costs shown in Exhibit 6 are calculated by dividing total costs by the volume of California RFG, even though Arizona gasoline is ethanol-blended and conventional gasoline is assumed to contain no oxygenates. This is consistent with calculations in the previous study (except where a national MTBE ban was considered).

The reduction in refining costs and the mileage benefits shown in Exhibit 7 are calculated relative to the corresponding case in series "B," i.e., the cases in which ethanol is blended at 2.7 wt% oxygen.

Table A: CEC Specified Cases and Modeling Assumptions

Case Definition	MTBE			Ethanol (2.0 wt%)					Ethanol (2.7 wt%)				No Oxygenate			Feinstein-Bilbray		
	Base 98	Base 1	Base 2	Case 1a	Case 2a	Case 3a	Case 4a	Sup 1a	Case 1b	Case 2b	Case 3b	Sup 1b	Case 1d	Case 2d	Case 3d	Case 1e	Case 2e	Case 3e
Predictive Model																		
Phase 2	x	x							x				x					
Phase 3			x	x	x	x	x		x	x	x		x	x	x	x	x	x
Reference Fuel																		
A	x	x	x	x				x	x			x	x			x		
B					x					x				x			x	
C						x					x				x			x
D							x											
Oxygenate																		
MTBE & TAME	x	x	x															
Ethanol																		
2.0 wt% Oxygen				x	x	x	x											
2.7 wt% Oxygen									x	x	x	x				x	x	x
3.5 wt% Oxygen																		
None													x	x	x	x	x	x
Emission Deltas																		
1998 Flat Recipe	x	x																
1998 In-Use Fuel			x	x					x				x			x		
ARB Specified				x	x	x	x			x	x	x		x	x		x	x
Property Compliance Margins																		
1998 Average Deltas	x	x												x	x		x	x
CEC Specified				x	x	x	x			x	x	x		x	x		x	x
None			x	x					x				x			x		
Arizona Gasoline																		
Phase 1 RFG	x																	
Phase 2 RFG		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
MTBE & TAME Blending	x	x	x															
Ethanol Blending				x	x	x	x	x										
2.0 wt% Oxygen									x	x	x	x	x	x	x	x	x	x
2.7 wt% Oxygen										x	x	x	x	x	x	x	x	x
Conventional Gasoline																		
MTBE & TAME Blending	x	x	x															
No Oxygenate				x	x	x	x	x	x	x	x	x	x	x	x			
Combined Ariz. & Conv.																x	x	x

Note: CEC specified cases with ethanol blending at 3.5 wt% oxygen were infeasible and are not reported.

Table B: Reference Fuels

Properties	Reference Fuel Designation			
	A	B	C	D
RVP (psi)	7	6.9	6.9	7
Oxygen (wt%)	2	2	2	2
Aromatics (vol%)	25	25	25	25
Benzene (vol%)	1	0.8	0.8	0.8
Olefins (vol%)	6	6	6	6
Sulfur (ppm)	40	20	20	20
T50	210	211	214	211
T90	300	305	310	305

Table C: Emission Deltas

Type of Emission	Emission Deltas		
	Calculated Using Average of Flat Limit Recipes in 1998 & Phase 2 Predictive Model	Calculated Using Average Properties of In-Use Fuel in 1998 & Phase 2 Predictive Model	Specified by ARB
THC	-0.900	-3.588	-0.100
NOx	-0.360	-3.915	-0.200
Toxics	-0.599	-11.599	-0.200

Table D: Property Compliance Margins

Properties	Compliance Margins	
	Weighted Average of 1998 Property Deltas	Specified by CEC
RVP (psi)	0.22	0.22
Oxygen (wt%)	--	--
Aromatics (vol%)	1.9	1.9
Benzene (vol%)	0.18	0.18
Olefins (vol%)	2.3	2.3
Sulfur (ppm)	5.7	4.0
T50	3.5	4.0
T90	7.2	7.0

**Exhibit 1: Process Unit Utilization, Additions, and Operations
(K bbl/d)**

Type of Process	Process	Phase 2 PM			Phase 3 PM					PM-2
		MTBE		RF A Delta Obs	Ethanol (2.0 wt%)				RF D Delta ARB	RF A Delta ARB
		RF A Delta Obs	RFA Delta Obs		RF B Delta ARB	RF C Delta ARB	RF D Delta ARB	RF A Delta ARB		
Case Name-->	Base 98	Base 1	Base 2	Case 1a	Case 2a	Case 3a	Case 4a	Sup 1a		
USE OF EXISTING CAPACITY										
Crude Distillation	Atmospheric	1,992	1,990	1,992	2,001	2,006	1,997	2,015	1,995	
Conversion	Fluid Cat Cracker	721	720	721	725	727	723	730	722	
	Hydrocracker - Distillate Feed	284	284	284	291	291	287	291	291	
	Hydrocracker - Gas Oil Feed	143	143	143	143	143	143	143	143	
	Coking - Delayed	385	384	385	386	387	386	390	385	
	Coking - Fluid & Flexi	106	106	106	106	106	106	106	106	
Upgrading	Alkylation	163	166	162	172	161	161	161	172	
	Dimersol	1		1	5	5	6	4	4	
	Pen/Hex Isomerization	68	68	68	58	68	4	58	60	
	Polymerization	5	5	5	6	6	66	6	6	
	Reforming (150-350 psi)	344	344	350	374	377	377	382	373	
Oxygenate Prod.	MTBE Plant	12	12	12						
	Tame Plant	2	2	2						
Hydrotreating	Naphtha & Isom Feed Desulf.	74	74	76	61	65	76	63	76	
	Reformer Feed Desulfurization	287	288	297	286	282	287	291	274	
	Distillate Desulfurization	355	358	361	373	374	364	375	372	
	Distillate Dearomatization	113	112	112	109	109	113	108	109	
	FCC Feed Desulf. -- Conv.	344	344	344	346	347	345	349	345	
	FCC Feed Desulf. -- Deep	373	372	373	375	376	374	378	374	
	FCC Naphtha Hydrotreater	101	97	101	90	101	101	101	101	
Hydrogen (foeb)	Benzene Saturation	66	66	66	66	66	66	66	66	
	Hydrogen Plant (foeb)	1,309	1,312	1,316	1,310	1,321	1,327	1,322	1,306	
Other	Butane Isomerization	18	18	18	18	18	18	18	18	
	Lubes & Waxes	25	25	25	25	25	25	25	25	
	Solvent Deasphalting	50	50	50	50	50	50	50	50	
	Sulfur Recovery (tons/d)	5,990	5,986	5,996	6,000	6,000	6,000	6,000	6,000	
Fractionation	Debutanization	196	197	197	197	197	197	197	197	
	Depentanization	64	64	64	64	64	64	64	64	
	Lt. Naphtha Spl. (Benz. Prec.)	112	114	109	114	114	114	114	114	
	FCC Naphtha Splitter	178	178	178	178	178	178	178	178	
	FCC Naphtha T90 Control	29	29	29	29	29	29	29	29	
NEW CAPACITY										
Upgrading	Alkylation				0	19	11	12		
	Pen/Hex Isomerization									
	Polymerization									
Hydrotreating	Naphtha & Isom Feed Desulf.									
	FCC Naphtha Hydrotreater					26	21	2		
	Benzene Saturation				5	11		7		
Hydrogen (foeb)	Hydrogen Plant (foeb)									
Other	Butane Isomerization									
	Propane Dehydrogenation									
	FCC Gas Processing				1	14				
	Sulfur Recovery (tons/d)				26	43	12	79	7	
Fractionation	Debutanization			0	23	21	20	23	20	
	Depentanization				128	106	22	54	103	
	Lt. Naphtha Spl. (Benz. Prec.)				94	89	94	98	81	
	Naphtha Splitter (T90 Control)									
	Alkylate Splitting (T90 Control)									
	Heavy Reformate Splitter									
	FCC Naphtha Splitter		0		119	130	85	122	114	
	FCC Naphtha (T90 Control)	0	26	6	231	243	195	232	235	
OPERATIONS										
Operating Indices	FCC Conversion (Vol %)	71	71	70	75	73	74	74	74	
	Reformer Severity (RON)	100	100	100	100	100	100	100	100	
Charge Rates	Fluid Cat Cracker	721	720	721	725	727	723	730	722	
	Reformer (150-350 psi)	344	344	350	374	377	377	382	373	
FCC Olefin Max Cat. (%)					0	2				

**Exhibit 1: Process Unit Utilization, Additions, and Operations
(K bbl/d)**

Type of Process	Process	Case Name-->	Phase 3 PM		PM-2	Phase 3 PM			
			Ethanol (2.7 wt%)				No Oxygenate		
			RF A	RF B	RF C	RF A	RF A	RF B	
			Delta ARB	Delta ARB	Delta ARB	Delta ARB	Delta ARB	Delta ARB	
Crude Distillation	Atmospheric	Case 1b	2,011	2,018	2,018	1,972	1,911	1,906	1,935
USE OF EXISTING CAPACITY									
Conversion	Fluid Cat Cracker	Case 2b	729	732	732	712	687	685	697
	Hydrocracker - Distillate Feed	Case 3b	291	291	291	290	284	291	291
	Hydrocracker - Gas Oil Feed	Sup 1b	143	143	143	143	143	143	143
	Coking - Delayed	Case 1d	389	392	393	380	363	362	369
	Coking - Fluid & Flexi	Case 2d	106	106	106	106	106	106	106
Upgrading	Alkylation	Case 3d	161	161	161	161	161	161	161
	Dimersol		4	1		0	5	5	5
	Pen/Hex Isomerization		70	73	76	70	86	86	86
	Polymerization		6	6	6	6	6	6	6
	Reforming (150-350 psi)		376	390	394	364	402	408	418
Oxygenate Prod.	MTBE Plant								
	Tame Plant								
Hydrotreating	Naphtha & Isom Feed Desulf.		76	76	76	76	62	64	73
	Reformer Feed Desulfurization		321	301	328	284	283	281	285
	Distillate Desulfurization		365	378	380	367	360	371	368
	Distillate Dearomatization		113	131	135	117	109	109	110
	FCC Feed Desulf. -- Conv.		348	349	349	340	328	327	333
	FCC Feed Desulf. -- Deep		377	379	379	368	355	354	361
	FCC Naphtha Hydrotreater		101	101	101	101	89	95	101
	Benzene Saturation		66	66	66	66	66	66	66
Hydrogen (foeb)	Hydrogen Plant (foeb)		1,352	1,371	1,371	1,330	1,290	1,306	1,329
Other	Butane Isomerization		18	18	18	18	18	18	18
	Lubes & Waxes		25	25	25	25	25	25	25
	Solvent Deasphalting		50	50	50	50	50	50	50
	Sulfur Recovery (tons/d)		6,000	6,000	6,000	5,939	5,740	5,732	5,822
Fractionation	Debutanization		197	197	197	197	197	197	197
	Depentanization		64	64	64	64	64	64	64
	Lt. Naphtha Spl. (Benz. Prec.)		114	114	114	114	114	114	114
	FCC Naphtha Splitter		178	178	178	178	178	178	178
	FCC Naphtha T90 Control		29	29	29	29	29	29	29
NEW CAPACITY									
Upgrading	Alkylation		13	7	4		21	27	9
	Pen/Hex Isomerization								
	Polymerization								
Hydrotreating	Naphtha & Isom Feed Desulf.			5	5				
	FCC Naphtha Hydrotreater		28	39	50		41	29	11
	Benzene Saturation						49	52	57
Hydrogen (foeb)	Hydrogen Plant (foeb)			20	29				
Other	Butane Isomerization						1	8	
	Propane Dehydrogenation								
	FCC Gas Processing						142	180	39
	Sulfur Recovery (tons/d)		72	109	114				
Fractionation	Debutanization		23	14	11	6	18	18	18
	Depentanization		18	36	110	75	78	66	22
	Lt. Naphtha Spl. (Benz. Prec.)		8	48		26	86	86	89
	Naphtha Splitter (T90 Control)						79	74	78
	Alkylate Splitting (T90 Control)								
	Heavy Reformate Splitter							7	
	FCC Naphtha Splitter		53	55	53		173	127	117
	FCC Naphtha (T90 Control)		193	200	136	71	214	222	228
OPERATIONS									
Operating Indices	FCC Conversion (Vol %)		74	69	68	69	74	73	73
	Reformer Severity (RON)		100	100	100	100	100	100	100
Charge Rates	Fluid Cat Cracker		729	732	732	711	687	685	697
	Reformer (150-350 psi)		376	390	394	362	402	408	418
FCC Olefin Max Cat. (%)							19	24	5

**Exhibit 1: Process Unit Utilization, Additions, and Operations
(K bbl/d)**

Type of Process	Process	Feinstein-Bilbray		
		Ethanol (2.7 wt%)/No Oxygenate		
		RF A	RF B	RF C
		Case Name-->	Case 1e	Case 2e
USE OF EXISTING CAPACITY				
Crude Distillation	Atmospheric	2,016	2,016	2,018
Conversion	Fluid Cat Cracker	731	731	732
	Hydrocracker - Distillate Feed	284	284	291
	Hydrocracker - Gas Oil Feed	143	143	143
	Coking - Delayed	391	392	392
	Coking - Fluid & Flexi	106	106	106
Upgrading	Alkylation	161	161	161
	Dimersol	3	2	1
	Pen/Hex Isomerization	86	86	86
	Polymerization	6	6	6
	Reforming (150-350 psi)	390	392	407
Oxygenate Prod.	MTBE Plant			
	Tame Plant			
Hydrotreating	Naphtha & Isom Feed Desulf.	76	76	76
	Reformer Feed Desulfurization	307	308	317
	Distillate Desulfurization	366	366	376
	Distillate Dearomatization	112	114	124
	FCC Feed Desulf. -- Conv.	349	349	349
	FCC Feed Desulf. -- Deep	378	378	379
	FCC Naphtha Hydrotreater	92	101	101
	Benzene Saturation	66	66	66
Hydrogen (foeb)	Hydrogen Plant (foeb)	1,313	1,318	1,360
Other	Butane Isomerization	18	18	18
	Lubes & Waxes	25	25	25
	Solvent Deasphalting	50	50	50
	Sulfur Recovery (tons/d)	6,000	6,000	6,000
Fractionation	Debutanization	197	197	197
	Depentanization	64	64	64
	Lt. Naphtha Spl. (Benz. Prec.)	114	114	114
	FCC Naphtha Splitter	178	178	178
	FCC Naphtha T90 Control	29	29	29
NEW CAPACITY				
Upgrading	Alkylation	6	4	7
	Pen/Hex Isomerization			
	Polymerization			
Hydrotreating	Naphtha & Isom Feed Desulf.			0
	FCC Naphtha Hydrotreater			
	Benzene Saturation			
Hydrogen (foeb)	Hydrogen Plant (foeb)			
Other	Butane Isomerization			
	Propane Dehydrogenation			
	FCC Gas Processing			
	Sulfur Recovery (tons/d)	79	85	106
Fractionation	Debutanization	16	12	15
	Depentanization		37	44
	Lt. Naphtha Spl. (Benz. Prec.)	98	98	99
	Naphtha Splitter (T90 Control)			
	Alkylate Splitting (T90 Control)			
	Heavy Reformate Splitter			
	FCC Naphtha Splitter			
	FCC Naphtha (T90 Control)	204	214	217
OPERATIONS				
Operating Indices	FCC Conversion (Vol %)	71	70	69
	Reformer Severity (RON)	100	100	100
Charge Rates	Fluid Cat Cracker	731	731	732
	Reformer (150-350 psi)	390	392	407
FCC Olefin Max Cat. (%)				

Exhibit 2A: Refinery Inputs
(K barrels/day)

Inputs	Phase 2 PM		Phase 3 PM					PM-2
	MTBE			Ethanol (2.0 wt%)				
	RF A	RFA	RF A	RF A	RF B	RF C	RF D	RFA
	Delta Obs	Delta Obs			Delta ARB	Delta ARB	Delta ARB	Delta ARB
Inputs	Base 98	Base 1	Base 2	Case 1a	Case 2a	Case 3a	Case 4a	Sup 1a
Crude Oil	1,992	1,990	1,992	2,000	2,005	1,996	2,014	1,995
Specified Inputs	68	68	68	68	68	68	68	68
Propylene Alkylate	6	6	6	6	6	6	6	6
Butylene Alkylate	6	6	6	6	6	6	6	6
Heavy Gas Oils	19	19	19	19	19	19	19	19
Residuum	38	38	38	38	38	38	38	38
Isobutane	0	3	0	0	5	0	0	1
P1		3			5			1
P2								
Isomerate	0	0	0	13	19	0	10	12
P1				10	10		10	10
P2				3	9			2
P3								
C7 Alkylate	0	0	0	100	100	100	100	100
P1				16	16	16	16	16
P2				22	22	22	22	22
P3				62	62	62	62	62
MTBE	107	107	107	0	0	0	0	0
P1	31	31	31					
P2	60	60	60					
P3	16	16	16					
Ethanol	0	0	0	63	63	63	63	63
P1				59	59	59	59	59
P2				4	4	4	4	4
P3								
CARBOB	0	0	0	0	0	0	0	0
P1								
P2								
P3								
Methanol	5	5	5					
Distillate Blendstocks								
Jet Fuel								
EPA Diesel								
Purchased Energy								
Electricity (K Kwh)	16,359	16,401	16,493	17,191	17,383	17,315	17,331	17,116
Fuel (foeb)	193	193	193	181	184	184	184	182

Exhibit 2A: Refinery Inputs
(K barrels/day)

Inputs	Phase 3 PM			PM-2	Phase 3 PM		
	Ethanol (2.7 wt%)				No Oxygenate		
	RF A	RF B	RF C	RF A	RF A	RF B	RF C
	Delta ARB	Delta ARB	Delta ARB	Delta ARB	Delta ARB	Delta ARB	Delta ARB
Crude Oil	2,011	2,018	2,018	1,971	1,911	1,905	1,934
Specified Inputs	68	68	68	68	68	68	68
Propylene Alkylate	6	6	6	6	6	6	6
Butylene Alkylate	6	6	6	6	6	6	6
Heavy Gas Oils	19	19	19	19	19	19	19
Residuum	38	38	38	38	38	38	38
Isobutane	0	0	0	0	12	12	1
P1					12	12	1
P2							
Isomerate	0	0	0	0	30	30	30
P1					10	10	10
P2					10	10	10
P3					10	10	10
C7 Alkylate	38	55	46	66	70	70	80
P1	16	16	16	16	16	16	16
P2	22	22	22	22	22	22	22
P3		17	8	28	32	32	42
MTBE	0	0	0	0	0	0	0
P1							
P2							
P3							
Ethanol	85	85	85	85	5	5	5
P1	59	59	59	59	5	5	5
P2	26	26	26	26			
P3							
CARBOB	0	0	0	0	150	150	100
P1					130	130	100
P2					20	20	
P3							
Methanol							
Distillate Blendstocks							
Jet Fuel							
EPA Diesel							
Purchased Energy							
Electricity (K Kwh)	17,333	17,608	17,578	16,878	17,520	17,464	17,636
Fuel (foeb)	187	195	197	189	176	187	185

Exhibit 2A: Refinery Inputs

(K barrels/day)

Inputs	Feinstein-Bilbray		
	Ethanol (2.7 wt%)/No Oxygenate		
	RF A	RF B	RF C
		Delta ARB	Delta ARB
Case 1e	Case 2e	Case 3e	
Crude Oil	2,015	2,016	2,018
Specified Inputs	68	68	68
Propylene Alkylate	6	6	6
Butylene Alkylate	6	6	6
Heavy Gas Oils	19	19	19
Residuum	38	38	38
Isobutane	0	0	0
P1			
P2			
Isomerate	5	5	3
P1	5	5	3
P2			
P3			
C7 Alkylate	83	100	78
P1	16	16	16
P2	22	22	22
P3	45	62	40
MTBE	0	0	0
P1			
P2			
P3			
Ethanol	54	54	54
P1	54	54	54
P2			
P3			
CARBOB	0	0	0
P1			
P2			
P3			
Methanol			
Distillate Blendstocks			
Jet Fuel			
EPA Diesel			
Purchased Energy			
Electricity (K Kwh)	17,324	17,346	17,732
Fuel (foeb)	186	188	191

Exhibit 2B: Prices of Refinery Inputs
(\$ per barrel)

Inputs	Phase 2 PM		Phase 3 PM					PM-2
	MTBE			Ethanol (2.0 wt%)				
	RF A	RFA	RF A	RF A	RF B	RF C	RF D	RFA
	Delta Obs	Delta Obs	RF A	Delta ARB	Delta ARB	Delta ARB	Delta ARB	Delta ARB
Inputs	Base 98	Base 1	Base 2	Case 1a	Case 2a	Case 3a	Case 4a	Sup 1a
Isobutane								
P1	22.19	22.19	22.19	22.19	22.19	22.19	22.19	22.19
P2	24.36	24.36	24.36	24.36	24.36	24.36	24.36	24.36
Isomerate								
P1	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00
P2	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00
P3	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00
C7 Alkylate								
P1	32.34	32.34	32.34	35.28	35.28	35.28	35.28	35.28
P2	32.92	32.92	32.92	35.86	35.86	35.86	35.86	35.86
P3	34.23	34.23	34.23	37.17	37.17	37.17	37.17	37.17
MTBE								
P1	31.92	31.92	31.92	31.92	31.92	31.92	31.92	31.92
P2	34.86	34.86	34.86	34.86	34.86	34.86	34.86	34.86
P3	39.06	39.06	39.06	39.06	39.06	39.06	39.06	39.06
Ethanol								
P1				40.24	40.24	40.24	40.24	40.24
P2				43.55	43.55	43.55	43.55	43.55
P3				50.40	50.40	50.40	50.40	50.40
CARBOB								
P1	29.74	29.74	29.74	29.74	29.74	29.74	29.74	29.74
P2	29.90	29.90	29.90	29.90	29.90	29.90	29.90	29.90
P3	31.32	31.32	31.32	31.32	31.32	31.32	31.32	31.32
Methanol	28.56	28.56	28.56	28.56	28.56	28.56	28.56	28.56
Distillate Blendstocks	25.50	25.50	25.50	25.50	25.50	25.50	25.50	25.50
Jet Fuel	26.50	26.50	26.50	26.50	26.50	26.50	26.50	26.50
EPA Diesel	25.80	25.80	25.80	25.80	25.80	25.80	25.80	25.80

Exhibit 2B: Prices of Refinery Inputs
(\$ per barrel)

Inputs	Phase 3 PM			PM-2	Phase 3 PM		
	Ethanol (2.7 wt%)				No Oxygenate		
	RF A	RF B	RF C	RF A	RF A	RF B	RF C
	Delta ARB	Delta ARB	Delta ARB	Delta ARB	Delta ARB	Delta ARB	Delta ARB
Case 1b	Case 2b	Case 3b	Sup 1b	Case 1d	Case 2d	Case 3d	
Isobutane							
P1	22.19	22.19	22.19	22.19	22.19	22.19	22.19
P2	24.36	24.36	24.36	24.36	24.36	24.36	24.36
Isomerate							
P1	26.00	26.00	26.00	26.00	26.00	26.00	26.00
P2	27.00	27.00	27.00	27.00	27.00	27.00	27.00
P3	28.00	28.00	28.00	28.00	28.00	28.00	28.00
C7 Alkylate							
P1	35.28	35.28	35.28	35.28	35.28	35.28	35.28
P2	35.86	35.86	35.86	35.86	35.86	35.86	35.86
P3	37.17	37.17	37.17	37.17	37.17	37.17	37.17
MTBE							
P1	31.92	31.92	31.92	31.92	31.92	31.92	31.92
P2	34.86	34.86	34.86	34.86	34.86	34.86	34.86
P3	39.06	39.06	39.06	39.06	39.06	39.06	39.06
Ethanol							
P1	40.24	40.24	40.24	40.24	34.52	34.52	34.52
P2	43.55	43.55	43.55	43.55			
P3	50.40	50.40	50.40	50.40			
CARBOB							
P1	29.74	29.74	29.74	29.74	29.74	29.74	29.74
P2	29.90	29.90	29.90	29.90	29.90	29.90	29.90
P3	31.32	31.32	31.32	31.32	31.32	31.32	31.32
Methanol	28.56	28.56	28.56	28.56	28.56	28.56	28.56
Distillate Blendstocks	25.50	25.50	25.50	25.50	25.50	25.50	25.50
Jet Fuel	26.50	26.50	26.50	26.50	26.50	26.50	26.50
EPA Diesel	25.80	25.80	25.80	25.80	25.80	25.80	25.80

Exhibit 2B: Prices of Refinery Inputs
 (\$ per barrel)

Inputs	Feinstein-Bilbray		
	Ethanol (2.7 wt%)/No Oxygenate		
	RF A	RF B	RF C
		Delta ARB	Delta ARB
Case 1e	Case 2e	Case 3e	
Isobutane			
P1	22.19	22.19	22.19
P2	24.36	24.36	24.36
Isomerate			
P1	26.00	26.00	26.00
P2	27.00	27.00	27.00
P3	28.00	28.00	28.00
C7 Alkylate			
P1	35.28	35.28	35.28
P2	35.86	35.86	35.86
P3	37.17	37.17	37.17
MTBE			
P1	31.92	31.92	31.92
P2	34.86	34.86	34.86
P3	39.06	39.06	39.06
Ethanol			
P1	38.72	38.72	38.72
P2			
P3			
CARBOB			
P1	29.74	29.74	29.74
P2	29.90	29.90	29.90
P3	31.32	31.32	31.32
Methanol	28.56	28.56	28.56
Distillate Blendstocks	25.50	25.50	25.50
Jet Fuel	26.50	26.50	26.50
EPA Diesel	25.80	25.80	25.80

Exhibit 2C: Availability of Refinery Inputs, by Case
(K bbl/d)

Inputs	Phase 2 PM		Phase 3 PM					PM-2
	MTBE			Ethanol (2.0 wt%)				
	RF A	RFA	RF A	RF A	RF B	RF C	RF D	RFA
	Delta Obs	Delta Obs	RF A	Delta ARB	Delta ARB	Delta ARB	Delta ARB	Delta ARB
Inputs	Base 98	Base 1	Base 2	Case 1a	Case 2a	Case 3a	Case 4a	Sup 1a
Isobutane								
P1	12	12	12	12	12	12	12	12
P2								
Isomerate								
P1	10	10	10	10	10	10	10	10
P2	10	10	10	10	10	10	10	10
P3	10	10	10	10	10	10	10	10
C7 Alkylate								
P1	16	16	16	16	16	16	16	16
P2	22	22	22	22	22	22	22	22
P3	62	62	62	62	62	62	62	62
MTBE								
P1	31	31	31	31	31	31	31	31
P2	60	60	60	60	60	60	60	60
P3								
Ethanol								
P1				59	59	59	59	59
P2				27	27	27	27	27
P3								
CARBOB								
P1	130	130	130	130	130	130	130	130
P2	26	26	26	26	26	26	26	26
P3	44	44	44	44	44	44	44	44
Methanol								
Distillate Blendstocks								
Jet Fuel								
EPA Diesel								

**Exhibit 2C: Availability of Refinery Inputs, by Case
(K bbl/d)**

Inputs	Phase 3 PM			PM-2	Phase 3 PM		
	Ethanol (2.7 wt%)				No Oxygenate		
	RF A	RF B	RF C	RF A	RF A	RF B	RF C
	Delta ARB	Delta ARB	Delta ARB	Delta ARB	Delta ARB	Delta ARB	Delta ARB
Case 1b	Case 2b	Case 3b	Sup 1b	Case 1d	Case 2d	Case 3d	
Isobutane							
P1	12	12	12	12	12	12	12
P2							
Isomerate							
P1	10	10	10	10	10	10	10
P2	10	10	10	10	10	10	10
P3	10	10	10	10	10	10	10
C7 Alkylate							
P1	16	16	16	16	16	16	16
P2	22	22	22	22	22	22	22
P3	62	62	62	62	62	62	62
MTBE							
P1	31	31	31	31	31	31	31
P2	60	60	60	60	60	60	60
P3							
Ethanol							
P1	59	59	59	59	13	13	13
P2	27	27	27	27			
P3							
CARBOB							
P1	130	130	130	130	130	130	130
P2	26	26	26	26	26	26	26
P3	44	44	44	44	44	44	44
Methanol							
Distillate Blendstocks							
Jet Fuel							
EPA Diesel							

**Exhibit 2C: Availability of Refinery Inputs, by Case
(K bbl/d)**

Inputs	Feinstein-Bilbray			
	Ethanol (2.7 wt%)/No Oxygenate			
	RF A	RF B	RF C	Delta ARB
	Case 1e	Case 2e	Case 3e	Delta ARB
Isobutane				
P1	12	12	12	
P2				
Isomerate				
P1	10	10	10	
P2	10	10	10	
P3	10	10	10	
C7 Alkylate				
P1	16	16	16	
P2	22	22	22	
P3	62	62	62	
MTBE				
P1	31	31	31	
P2	60	60	60	
P3				
Ethanol				
P1	54	54	54	
P2				
P3				
CARBOB				
P1	130	130	130	
P2	26	26	26	
P3	44	44	44	
Methanol				
Distillate Blendstocks				
Jet Fuel				
EPA Diesel				

Exhibit 2D: Cost Adjustment for Blendstock and Refined Product Supply Curves
(\$K/day)

Inputs	Phase 2 PM			Phase 3 PM					PM-2
	MTBE		RF A Delta Obs	Ethanol (2.0 wt%)					
	RF A	RFA		RF A	RF B	RF C	RF D	RFA	
	Delta Obs	Delta Obs		Delta ARB	Delta ARB	Delta ARB	Delta ARB	Delta ARB	
Inputs	Base 98	Base 1	Base 2	Case 1a	Case 2a	Case 3a	Case 4a	Sup 1a	
Isobutane									
ARMS Cost	0	55	0	0	116	0	0	29	
Market Cost	0	55	0	0	116	0	0	29	
Adjustment	0	0	0	0	0	0	0	0	
Isomerate									
ARMS Cost	0	0	0	350	515	0	260	317	
Market Cost	0	0	0	360	525	0	260	327	
Adjustment	0	0	0	10	10	0	0	10	
C7 Alkylate									
ARMS Cost	0	0	0	3,658	3,658	3,658	3,658	3,658	
Market Cost	0	0	0	3,717	3,717	3,717	3,717	3,717	
Adjustment	0	0	0	59	59	59	59	59	
MTBE									
ARMS Cost	3,710	3,710	3,710	0	0	0	0	0	
Market Cost	4,184	4,184	4,184	0	0	0	0	0	
Adjustment	473	473	473	0	0	0	0	0	
Ethanol									
ARMS Cost	0	0	0	2,533	2,533	2,533	2,533	2,533	
Market Cost	0	0	0	2,728	2,728	2,728	2,728	2,728	
Adjustment	0	0	0	195	195	195	195	195	
CARBOB									
ARMS Cost	0	0	0	0	0	0	0	0	
Market Cost	0	0	0	0	0	0	0	0	
Adjustment	0	0	0	0	0	0	0	0	
Total Adjustment	473	473	473	264	264	254	254	264	

Exhibit 2D: Cost Adjustment for Blendstock and Refined Product Supply Curves
(\$K/day)

Inputs	Phase 3 PM			PM-2	Phase 3 PM		
	Ethanol (2.7 wt%)				No Oxygenate		
	RF A	RF B	RF C	RF A	RF A	RF B	RF C
	Delta ARB	Delta ARB	Delta ARB	Delta ARB	Delta ARB	Delta ARB	Delta ARB
Inputs	Case 1b	Case 2b	Case 3b	Sup 1b	Case 1d	Case 2d	Case 3d
Isobutane							
ARMS Cost	0	0	0	0	266	266	30
Market Cost	0	0	0	0	266	266	30
Adjustment	0	0	0	0	0	0	0
Isomerate							
ARMS Cost	0	0	0	0	810	810	810
Market Cost	0	0	0	0	840	840	840
Adjustment	0	0	0	0	30	30	30
C7 Alkylate							
ARMS Cost	1,353	1,993	1,660	2,412	2,543	2,543	2,915
Market Cost	1,363	2,052	1,720	2,471	2,602	2,602	2,974
Adjustment	9	59	59	59	59	59	59
MTBE							
ARMS Cost	0	0	0	0	0	0	0
Market Cost	0	0	0	0	0	0	0
Adjustment	0	0	0	0	0	0	0
Ethanol							
ARMS Cost	3,488	3,488	3,488	3,488	182	182	182
Market Cost	3,683	3,683	3,683	3,683	182	182	182
Adjustment	195	195	195	195	0	0	0
CARBOB							
ARMS Cost	0	0	0	0	4,464	4,464	2,974
Market Cost	0	0	0	0	4,485	4,485	2,974
Adjustment	0	0	0	0	21	21	0
Total Adjustment	205	254	254	254	110	110	89

Exhibit 2D: Cost Adjustment for Blendstock and Refined Product Supply Curves
(\$K/day)

Inputs	Feinstein-Bilbray		
	Ethanol (2.7 wt%)/No Oxygenate		
	RF A	RF B	RF C
		Delta ARB	Delta ARB
Case 1e	Case 2e	Case 3e	
Isobutane			
ARMS Cost	0	0	0
Market Cost	0	0	0
Adjustment	0	0	0
Isomerate			
ARMS Cost	120	132	84
Market Cost	120	132	84
Adjustment	0	0	0
C7 Alkylate			
ARMS Cost	3,039	3,658	2,839
Market Cost	3,098	3,717	2,898
Adjustment	59	59	59
MTBE			
ARMS Cost	0	0	0
Market Cost	0	0	0
Adjustment	0	0	0
Ethanol			
ARMS Cost	2,072	2,072	2,072
Market Cost	2,072	2,072	2,072
Adjustment	0	0	0
CARBOB			
ARMS Cost	0	0	0
Market Cost	0	0	0
Adjustment	0	0	0
Total Adjustment	59	59	59

Exhibit 3: Refined Product Outputs and Sales of Rejected Blendstocks
(K barrels/day)

Outputs	Phase 2 PM			Phase 3 PM				PM-2
	MTBE			Ethanol (2.0 wt%)				
	RF A Delta Obs	RFA Delta Obs	RFA	RF A	RF B Delta ARB	RF C Delta ARB	RF D Delta ARB	RF A Delta ARB
	Base 98	Base 1	Base 2	Case 1a	Case 2a	Case 3a	Case 4a	Sup 1a
REFINED PRODUCTS	2,237	2,237	2,237	2,243	2,256	2,236	2,252	2,251
Propane	37	37	37	37	37	37	37	37
Propylene	2	2	2	2	2	2	2	2
Butane	30	30	30	30	30	30	30	30
Mixed Butylenes	4	4	4	4	4	4	4	4
Naphtha	3	3	3	3	3	3	3	3
Gasoline:								
California RFG	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022
Arizona RFG	68	68	68	68	68	68	68	68
Conventional	161	161	161	161	161	161	161	161
Aviation Gasoline	5	5	5	5	5	5	5	5
Jet Fuel	333	333	333	333	333	333	333	333
Diesel Fuel:								
CARB Diesel	204	204	204	204	204	204	204	204
EPA Diesel	122	122	122	122	122	122	122	122
Other	18	18	18	18	18	18	18	18
Lubes & Waxes	25	25	25	25	25	25	25	25
Residual Fuel Oil	58	58	58	64	77	57	72	72
Asphalt								
Coke	144	144	145	145	145	145	146	145
Sulfur (K tons/d)	6	6	6	6	6	6	6	6
REJECTED BLENDSTOCKS	0	0	0	47	49	39	49	34
Mixed Butylenes				5	1	5	5	4
Pentanes				28	27	9	18	16
Light Coker Naphtha								
Light FCC Gasoline				13	20	25	25	14
Heavy FCC Gasoline								
Naphtha (250 - 325 °F)								
Heavy Reformate								
TOTAL	2,237	2,237	2,237	2,290	2,305	2,275	2,301	2,285

Exhibit 3: Refined Product Outputs and Sales of Rejected Blendstocks
(K barrels/day)

Outputs	Phase 3 PM				PM-2		Phase 3 PM			
	Ethanol (2.7 wt%)				No Oxygenate					
	RF A	RF B	RF C	RF A	RF A	RF B	RF C	Delta ARB	Delta ARB	Delta ARB
	Case 1b	Case 2b	Case 3b	Sup 1b	Case 1d	Case 2d	Case 3d			
REFINED PRODUCTS	2,237	2,261	2,260	2,235	2,079	2,079	2,131			
Propane	37	37	37	37	37	37	37			
Propylene	2	2	2	2	2	2	2			
Butane	30	30	30	30	30	30	30			
Mixed Butylenes	4	4	4	4	4	4	4			
Naphtha	3	3	3	3	3	3	3			
Gasoline:										
California RFG	1,022	1,022	1,022	1,022	872	872	922			
Arizona RFG	68	68	68	68	68	68	68			
Conventional	161	161	161	161	161	161	161			
Aviation Gasoline	5	5	5	5	5	5	5			
Jet Fuel	333	333	333	333	333	333	333			
Diesel Fuel:										
CARB Diesel	204	204	204	204	204	204	204			
EPA Diesel	122	122	122	122	122	122	122			
Other	18	18	18	18	18	18	18			
Lubes & Waxes	25	25	25	25	25	25	25			
Residual Fuel Oil	57	80	79	58	57	57	57			
Asphalt										
Coke	146	147	147	143	138	137	140			
Sulfur (K tons/d)	6	6	6	6	6	6	6			
REJECTED BLENDSTOCKS	16	22	15	13	48	52	27			
Mixed Butylenes	4	5	6	7	8	13	4			
Pentanes	1	2	5	3	13	9	1			
Light Coker Naphtha										
Light FCC Gasoline	11	15	4	3	11	15	22			
Heavy FCC Gasoline										
Naphtha (250 - 325 °F)										
Heavy Reformate					16	15				
TOTAL	2,254	2,282	2,275	2,248	2,127	2,131	2,158			

Exhibit 3: Refined Product Outputs and Sales of Rejected Blendstocks
(K barrels/day)

Outputs	Feinstein-Bilbray			
	Ethanol (2.7 wt%)/No Oxygenate			
	RF A	RF B Delta ARB	RF C	Delta ARB
	Case 1e	Case 2e	Case 3e	
REFINED PRODUCTS	2,267	2,278	2,264	
Propane	37	37	37	
Propylene	2	2	2	
Butane	30	30	30	
Mixed Butylenes	4	4	4	
Naphtha	3	3	3	
Gasoline:				
California RFG (Ethanol Blended)	622	622	622	
California RFG (No Oxygenates)	400	400	400	
Arizona & Conventional	229	229	229	
Aviation Gasoline	5	5	5	
Jet Fuel	333	333	333	
Diesel Fuel:				
CARB Diesel	204	204	204	
EPA Diesel	122	122	122	
Other	18	18	18	
Lubes & Waxes	25	25	25	
Residual Fuel Oil	86	97	83	
Asphalt				
Coke	146	147	147	
Sulfur (K tons/d)	6	6	6	
REJECTED BLENDSTOCKS	6	14	7	
Mixed Butylenes	6	7	5	
Pentanes	0	2	2	
Light Coker Naphtha				
Light FCC Gasoline		6		
Heavy FCC Gasoline				
Naphtha (250 - 325 °F)				
Heavy Reformate				
TOTAL	2,273	2,292	2,271	

Exhibit 4: Gasoline Properties

Property & Predictive Model % Emissions	Phase 2 PM						Phase 3 PM		
	MTBE								
	RF A Delta Obs			RF A Delta Obs			RF A		
	Base 98			Base 1			Base 2		
	CARB	Ariz.	Conv.	CARB	Ariz.	Conv.	CARB	Ariz.	Conv.
Property									
RVP (psi)	6.8	6.7	8.1	6.8	6.6	8.1	6.7	6.6	8.1
Oxygen (wt%)	2.0	2.0	0.1	2.0	2.0	0.1	2.0	2.0	0.1
Aromatics (vol%)	24.2	28.0	34.4	24.4	21.1	34.4	24.5	26.6	34.4
Benzene (vol%)	0.60	0.65	0.65	0.58	0.65	0.65	0.55	0.65	0.65
Olefins (vol%)	4.1	5.2	10.0	4.1	5.2	10.0	4.2	5.2	10.0
Sulfur (ppm)	21.8	35.0	90.0	21.8	35.0	90.0	21.2	35.0	90.0
E200 (vol% off)	49.5	43.0	38.9	49.6	43.0	38.9	48.9	46.6	38.9
E300 (vol% off)	87.4	76.2	78.5	87.1	84.4	78.5	86.4	84.4	78.5
T10 (1)	134	137	140	134	136	136	134	135	140
T50 (2)	201	219	229	201	219	229	203	209	229
T90 (3)	307	339	333	308	316	333	310	316	333
Estimated DI (4)	1152	1240	1232	1153	1215	1227	1160	1185	1233
En. Den. (MM Btu/bbl)	5.138	5.213	5.277	5.144	5.152	5.257	5.150	5.136	5.264
Predictive Model % Emissions (5)									
VOCs	-0.93			-0.87			-3.56		
NOx	-0.40			-0.41			-3.95		
Toxics	-0.70			-0.75			-11.59		

(1) Linear interpolations from ARMS generated distillation curves.

(2) Calculated using formula: $T50 = (125.3846 - E200)/0.3769$.(3) Calculated using formula: $T90 = (196.1538 - E300)/0.3538$.(4) Calculated as follows: $1.5*T10 + 3.0*T50 + 1.0*T90 + 20*(\text{wt\% oxygen})$

(5) % emissions are calculated by adding "Property Compliance Margins"

(observed and specified by ARB) to the gasoline properties shown above.

Exhibit 4: Gasoline Properties

Property & Predictive Model % Emissions	Phase 3 PM												Phase 2 PM		
	Ethanol (2.0 wt%)														
	RF A			RF B			RF C			RF D			RF A		
	Case 1a			Case 2a			Case 3a			Case 4a			Sup 1a		
	CARB	Ariz.	Conv.	CARB	Ariz.	Conv.	CARB	Ariz.	Conv.	CARB	Ariz.	Conv.	CARB	Ariz.	Conv.
Property															
RVP (psi)	6.6	6.6	8.1	6.6	6.6	8.1	6.6	6.6	8.1	6.6	6.6	8.1	6.8	6.6	8.1
Oxygen (wt%)	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0	0.0
Aromatics (vol%)	24.6	18.0	34.4	24.2	18.0	34.4	25.0	18.0	34.4	24.8	18.0	34.4	24.1	18.0	34.4
Benzene (vol%)	0.53	0.65	0.65	0.55	0.65	0.65	0.55	0.65	0.65	0.50	0.65	0.65	0.69	0.65	0.65
Olefins (vol%)	4.4	5.2	10.0	3.3	5.2	10.0	3.3	5.2	10.0	3.4	5.2	10.0	3.6	5.2	10.0
Sulfur (ppm)	20.3	35.0	90.0	10.4	35.0	90.0	14.0	35.0	90.0	14.4	35.0	90.0	17.5	35.0	90.0
E200 (vol% off)	46.8	43.0	38.9	47.0	43.0	38.9	46.2	43.0	38.9	46.6	43.0	38.9	47.9	43.0	38.9
E300 (vol% off)	88.4	82.0	78.5	89.0	82.0	78.5	88.2	82.0	78.5	88.4	82.0	78.5	88.7	82.0	78.5
T10 (1)	132	130	140	132	129	138	132	130	138	133	130	138	132	134	140
T50 (2)	208	219	229	208	219	229	210	219	229	209	219	229	206	219	229
T90 (3)	305	323	333	303	323	333	305	323	333	305	323	333	304	323	333
Estimated DI (4)	1169	1214	1231	1165	1212	1228	1174	1213	1228	1171	1213	1228	1158	1220	1231
En. Den. (MM Btu/bbl)	5.131	5.092	5.276	5.121	5.113	5.281	5.131	5.106	5.287	5.129	5.100	5.287	5.120	5.121	5.293
Predictive Model % Emissions (5)															
VOCs	-3.64			-0.12			-0.13			-0.11			-0.12		
NOx	-3.96			-0.96			-0.22			-0.20			-0.77		
Toxics	-11.84			-0.23			-0.23			-0.24			-0.27		

(1) Linear interpolations from ARMS generated distillation curves.

(2) Calculated using formula: $T50 = (125.3846 - E200)/0.3769$.(3) Calculated using formula: $T90 = (196.1538 - E300)/0.3538$.(4) Calculated as follows: $1.5*T10 + 3.0*T50 + 1.0*T90 + 20*(\text{wt\% oxygen})$

(5) % emissions are calculated by adding "Property Compliance Margins"

(observed and specified by ARB) to the gasoline properties shown above.

Exhibit 4: Gasoline Properties

Property & Predictive Model % Emissions	Phase 3 PM									Phase 2 PM		
	Ethanol (2.7 wt%)											
	RF A			RF B Delta ARB			RF C Delta ARB			RF A Delta ARB		
	Case 1b			Case 2b			Case 3b			Sup 1b		
	CARB	Ariz.	Conv.									
Property												
RVP (psi)	6.8	6.6	8.1	6.8	6.6	8.1	6.8	6.6	8.1	6.8	6.6	8.1
Oxygen (wt%)	2.7	2.7	0.0	2.7	2.7	0.0	2.7	2.7	0.0	2.7	2.7	0.0
Aromatics (vol%)	25.5	18.0	34.4	24.9	18.0	34.4	25.6	18.0	34.4	24.7	18.0	34.4
Benzene (vol%)	0.55	0.65	0.65	0.60	0.65	0.65	0.59	0.65	0.65	0.63	0.65	0.65
Olefins (vol%)	3.3	5.2	10.0	1.9	5.2	10.0	1.7	5.2	10.0	2.9	5.2	10.0
Sulfur (ppm)	11.9	35.0	90.0	7.8	35.0	90.0	7.8	35.0	90.0	21.9	35.0	90.0
E200 (vol% off)	47.4	43.0	38.9	48.0	43.0	40.2	47.3	43.0	40.3	48.4	43.0	38.9
E300 (vol% off)	87.2	81.6	78.5	88.2	81.4	78.5	86.6	81.4	78.5	87.2	81.6	78.5
T10 (1)	129	128	139	129	131	140	129	131	140	129	123	141
T50 (2)	207	219	229	205	219	226	207	219	226	204	219	229
T90 (3)	308	324	333	305	324	333	310	324	333	308	324	333
Estimated DI (4)	1177	1225	1229	1168	1231	1221	1178	1231	1220	1168	1219	1232
En. Den. (MM Btu/bbl)	5.109	5.092	5.301	5.101	5.099	5.280	5.111	5.100	5.291	5.103	5.071	5.317
Predictive Model % Emissions (5)												
VOCs	-3.66			-0.10			-0.13			-0.11		
NOx	-3.91			-0.21			-0.20			-0.24		
Toxics	-11.86			-0.21			-0.30			-0.23		

(1) Linear interpolations from ARMS generated distillation curves.

(2) Calculated using formula: T50 = (125.3846 - E200)/0.3769.

(3) Calculated using formula: T90 = (196.1538 - E300)/0.3538.

(4) Calculated as follows: 1.5*T10 + 3.0*T50 + 1.0*T90 + 20*(wt% oxygen)

(5) % emissions are calculated by adding "Property Compliance Margins"

(observed and specified by ARB) to the gasoline properties shown above.

Exhibit 4: Gasoline Properties

Property & Predictive Model % Emissions	Phase 3 PM								
	No Oxygenate								
	RF A			RF B Delta ARB			RF C Delta ARB		
	Case 1d			Case 2d			Case 3d		
	CARB	Ariz.	Conv.	CARB	Ariz.	Conv.	CARB	Ariz.	Conv.
Property									
RVP (psi)	6.6	6.6	8.1	6.6	6.6	8.1	6.6	6.6	8.1
Oxygen (wt%)	0.0	2.7	0.0	0.0	2.7	0.0	0.0	2.7	0.0
Aromatics (vol%)	26.1	22.2	34.4	26.0	18.0	34.4	27.3	18.4	34.4
Benzene (vol%)	0.55	0.65	0.65	0.52	0.65	0.65	0.49	0.65	0.65
Olefins (vol%)	4.3	5.0	10.0	3.5	5.2	10.0	3.2	5.2	10.0
Sulfur (ppm)	8.1	35.0	90.0	8.5	35.0	90.0	10.2	35.0	90.0
E200 (vol% off)	49.1	43.0	38.9	49.3	43.0	38.9	48.0	43.0	38.9
E300 (vol% off)	90.1	84.9	78.5	90.7	81.6	78.5	89.1	81.6	78.5
T10 (1)	139	128	140	139	129	141	139	129	140
T50 (2)	203	219	229	202	219	229	205	219	229
T90 (3)	300	314	333	298	324	333	303	324	333
Estimated DI (4)	1116	1216	1231	1112	1226	1232	1127	1227	1232
En. Den. (MM Btu/bbl)	5.192	5.087	5.275	5.189	5.080	5.275	5.198	5.083	5.287
Predictive Model % Emissions (5)									
VOCs	-3.63			-0.09			-0.12		
NOx	-7.27			-2.51			-2.05		
Toxics	-11.70			-0.21			-0.24		

(1) Linear interpolations from ARMS generated distillation curves.

(2) Calculated using formula: $T50 = (125.3846 - E200)/0.3769$.(3) Calculated using formula: $T90 = (196.1538 - E300)/0.3538$.(4) Calculated as follows: $1.5*T10 + 3.0*T50 + 1.0*T90 + 20*(\text{wt\% oxygen})$

(5) % emissions are calculated by adding "Property Compliance Margins"

(observed and specified by ARB) to the gasoline properties shown above.

Exhibit 4: Gasoline Properties

Property & Predictive Model % Emissions	Feinstein-Bilbray								
	Ethanol (2.7 wt%)/No Oxygenate								
	RF A			RF B Delta ARB			RF C Delta ARB		
	Case 1e			Case 2e			Case 3e		
	CARBeoh	CARBno	Az.&Cv.	CARBeoh	CARBno	Az.&Cv.	CARBeoh	CARBno	Az.&Cv.
Property									
RVP (psi)	6.9	6.6	7.7	6.7	6.6	7.7	6.8	6.6	7.7
Oxygen (wt%)	2.7	0.0	0.8	2.7	0.0	0.8	2.7	0.0	0.8
Aromatics (vol%)	30.0	17.2	29.5	28.1	19.3	29.5	28.1	21.4	29.5
Benzene (vol%)	0.46	0.60	0.65	0.50	0.50	0.65	0.53	0.46	0.65
Olefins (vol%)	2.9	6.0	8.6	1.3	5.7	8.6	1.8	5.7	8.6
Sulfur (ppm)	9.3	30.4	73.7	6.7	23.1	73.7	5.4	24.3	73.7
E200 (vol% off)	47.1	49.5	40.1	46.1	50.5	41.0	46.3	49.1	41.1
E300 (vol% off)	88.5	86.5	79.4	89.0	86.4	79.4	88.3	86.0	79.4
T10 (1)	131	136	134	130	138	136	130	138	134
T50 (2)	208	201	226	210	199	224	210	202	224
T90 (3)	304	310	330	303	310	330	305	311	330
Estimated DI (4)	1177	1117	1226	1183	1112	1221	1183	1126	1218
En. Den. (MM Btu/bbl)	5.123	5.169	5.230	5.113	5.181	5.221	5.112	5.208	5.211
Predictive Model % Emissions (5)									
VOCs	-3.63	-3.63		-0.15	-0.13		-0.11	-0.12	
NOx	-3.92	-5.53		-0.21	-1.02		-0.23	-0.23	
Toxics	-11.66	-11.66		-0.22	-0.26		-0.27	-0.31	

(1) Linear interpolations from ARMS generated distillation curves.

(2) Calculated using formula: T50 = (125.3846 - E200)/0.3769.

(3) Calculated using formula: T90 = (196.1538 - E300)/0.3538.

(4) Calculated as follows: 1.5*T10 + 3.0*T50 + 1.0*T90 + 20*(wt% oxygen)

(5) % emissions are calculated by adding "Property Compliance Margins"

(observed and specified by ARB) to the gasoline properties shown above.

Exhibit 5: Gasoline Composition and Volume

Gasoline Composition & Volume	Phase 2 PM								Phase 3 PM							
	MTBE															
	RF A				RF A				RF A							
	Delta Obs				Delta Obs											
	Base 98				Base 1				Base 2							
	CARB	Ariz.	Conv.	Pool	CARB	Ariz.	Conv.	Pool	CARB	Ariz.	Conv.	Pool	CARB	Ariz.	Conv.	Pool
Composition (vol%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
C4s:	0.6	2.0	4.5	1.2	0.9	1.3	3.3	1.2	0.5	2.1	4.3	1.1				
Butenes																
I-Butane																
N-Butane	0.6	2.0	4.5	1.2	0.9	1.3	3.3	1.2	0.5	2.1	4.3	1.1				
C5s & Isomerate	6.4	0.5	2.7	5.6	4.2	9.2	13.3	5.6	4.5	17.8	7.4	5.6				
Raffinate																
Natural Gas Liquids																
Naphtha	2.5	0.0	4.8	2.6	2.4	1.5	4.8	2.6	1.5	1.5	10.2	2.6				
C5-160	2.5		4.8	2.6	2.4	1.5	4.8	2.6	1.5	1.5	10.2	2.6				
Coker Naphtha																
160-250																
Alkylate	14.2	9.0	9.2	13.3	14.9	17.5	2.9	13.5	14.7	8.4	5.5	13.2				
Hydrocrackate	17.3	5.1	0.0	14.4	17.6	2.8		14.6	17.4	4.5	0.1	14.5				
Dimate																
Poly Gasoline	0.1			0.1					0.0	0.2	0.3	0.1				
FCC Gasoline:	25.6	59.3	50.5	30.6	27.6	44.8	41.5	30.3	28.5	31.2	42.5	30.4				
Full Range	17.3	29.0	6.6	16.5	20.0			16.4	20.1			16.4				
Light	1.9	0.4	0.4	1.7	1.8	0.9	1.1	1.7	1.8		1.2	1.6				
Light - Desulf.	0.6	3.3	4.4	1.2	0.6	7.0	2.5	1.2	1.3	3.1		1.2				
Medium	1.6		23.6	4.4	1.1	2.9	26.9	4.5	0.7	7.7	25.9	4.3				
Medum - Desulf.	2.7	14.9		3.0	2.2	19.2		2.8	3.0	10.2		3.0				
Heavy																
Heavy - Desulf.	1.5	11.7	15.5	3.9	1.9	14.8	11.0	3.7	1.6	10.1	15.4	3.8				
Reformate	22.3	13.0	27.6	22.5	21.4	11.9	33.7	22.5	21.8	23.2	29.2	22.9				
Light	8.6	7.2	22.5	10.3	9.5	11.9	13.6	10.2	8.1	10.9	19.1	9.6				
Medium																
Heavy	13.7	5.8	5.0	12.1	11.9		20.2	12.3	13.8	12.3	10.1	13.2				
Oxygenate	11.0	11.1	0.6	9.7	11.0	11.0	0.5	9.7	11.0	11.0	0.5	9.7				
MTBE	11.0	10.0		9.5	10.8	11.0	0.5	9.5	10.8	11.0	0.5	9.5				
Ethanol																
TBA																
ETBE																
TAME		1.1	0.6	0.1	0.2			0.1	0.2			0.1				
DIPE																
Volume (K Bbl/day)	1,022	68	161	1,251	1,022	68	161	1,251	1,022	68	161	1,251				

Exhibit 5: Gasoline Composition and Volume

Gasoline Composition & Volume	Phase 3 PM																PM-2				
	Ethanol (2.0 wt%)																				
	RF A				RF B Delta ARB				RF C Delta ARB				RF D Delta ARB				RF A Delta ARB				
	Case 1a				Case 2a				Case 3a				Case 4a				Sup 1a				
	CARB	Ariz.	Conv.	Pool																	
Composition (vol%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
C4s:	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Butenes																					
I-Butane																					
N-Butane	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
C5s & Isomerate	6.7		2.9	5.8	7.2		9.4	7.1	5.0	4.5	7.9	5.3	5.5			7.4	5.5	6.7	2.3	3.0	6.0
Raffinate																					
Natural Gas Liquids																					
Naphtha	2.6	1.5	0.0	2.2	1.9	2.4	0.0	1.7	3.2	2.7	0.0	2.8	3.0	0.0	1.7	2.7	2.3	23.7	4.9	3.8	
C5-160	2.5			2.0	1.4			1.1	3.2			2.6	3.0			1.7	2.7	1.2	18.6	4.9	2.6
Coker Naphtha																					
160-250	0.1	1.5		0.2	0.5	2.4		0.6		2.7		0.1						1.0	5.1		1.1
Alkylate	23.1	33.1	10.8	22.0	24.7	30.6	4.7	22.5	23.6	31.7	6.8	21.9	24.1	29.6	5.6	22.0	23.5	33.9	7.2	22.0	
Hydrocrackate	12.7	24.4	3.6	12.1	12.2	21.9	4.3	11.7	13.7	12.6	5.2	12.5	12.8	21.1	4.5	12.2	13.1	0.5	3.0	11.1	
Dimate																					
Poly Gasoline	0.5	0.7		0.5	0.5	0.9		0.5	0.5			0.4	0.5			0.4	0.4	1.5		0.4	
FCC Gasoline:	24.2	24.9	50.4	27.6	24.1	30.9	41.6	26.7	24.4	38.6	40.4	27.2	24.4	36.5	40.2	27.0	25.3	19.5	42.4	27.2	
Full Range	7.0		8.5	6.8	6.0	13.6		5.7	7.2	26.4	19.5	9.8	7.6			5.9	7.0	7.6		4.5	6.8
Light	1.3	2.9	19.0	3.7	1.2		18.9	3.5	0.6		16.4	2.6	0.7	2.6	18.3	3.1	1.3	1.2	18.0		3.4
Light - Desulf.																				1.0	0.1
Medium	9.3	5.4	7.3	8.8	6.8	6.6	16.5	8.1	7.2	4.8	1.8	6.4	7.1	7.4	11.7	7.7	7.1	7.1	12.8	7.8	
Medium - Desulf.	4.8			3.9	6.1			5.0	5.7			4.7	5.3	10.1			4.9	5.7			4.7
Heavy							6.1	0.8			1.1	0.1	2.0		4.3	2.2	1.3	5.9	6.2	2.2	
Heavy - Desulf.	1.9	12.8		2.2	3.9	10.8		3.7	3.7	7.4	1.7	3.7	1.6	16.3		2.2	2.3	5.3		2.2	
Reformate	23.9	9.3	31.9	24.2	23.1	7.0	39.6	24.3	23.4	3.7	39.2	24.4	23.5	6.6	40.2	24.7	22.5	12.3	39.0	24.1	
Light	9.0	9.3	27.5	11.4	12.6	5.2	7.6	11.5	11.6	2.2	12.4	11.2	12.6	6.6	7.6	11.7	12.4	0.9	10.4	11.5	
Medium																					
Heavy	14.9		4.4	12.8	10.5	1.8	32.1	12.8	11.7	1.5	26.8	13.1	10.8		32.6	13.0	10.1	11.4	28.6	12.6	
Oxygenate	5.7	5.7	0.0	5.0	5.7	5.7	0.0	5.0	5.7	5.7	0.0	5.0	5.7	5.7	0.0	5.0	5.7	5.7	0.0	5.0	
MTBE																					
Ethanol	5.7	5.7		5.0	5.7	5.7		5.0	5.7	5.7		5.0	5.7	5.7		5.0	5.7	5.7		5.0	
TBA																					
ETBE																					
TAME																					
DIPE																					
Volume (K Bbl/day)	1,022	68	161	1,251	1,022	68	161	1,251	1,022	68	161	1,251	1,022	68	161	1,251	1,022	68	161	1,251	

Exhibit 5: Gasoline Composition and Volume

Gasoline Composition & Volume	Phase 3 PM												Phase 2 PM				
	Ethanol (2.7 wt%)																
	RF A				RF B Delta ARB				RF C Delta ARB				RF A Delta ARB				
	Case 1b				Case 2b				Case 3b				Sup 1b				
	CARB	Ariz.	Conv.	Pool													
Composition (vol%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
C4s:	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Butenes																	
I-Butane																	
N-Butane	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
C5s & Isomerate	6.7		1.9	5.7	6.7	3.1	2.3	6.0	7.0	2.9	3.9	6.4	5.6	15.7	3.2	5.9	
Raffinate																	
Natural Gas Liquids																	
Naphtha	2.5	0.0	4.7	2.7	2.9	5.1	0.0	2.7	2.3	5.1	0.0	2.2	2.6	0.0	3.6	2.6	
C5-160	2.5		4.7	2.7	2.9	5.1		2.7	2.3	5.1		2.2	2.6		3.6	2.6	
Coker Naphtha																	
160-250																	
Alkylate	18.0	24.3	8.4	17.1	19.6	23.4	5.5	18.0	18.7	23.1	4.7	17.1	19.5	25.2	8.8	18.4	
Hydrocrackate	15.6	20.1	0.9	14.0	17.1			13.9	17.0			13.9	15.8	14.6	1.1	13.9	
Dimate																	
Poly Gasoline	0.5	0.1		0.4	0.2			0.2	0.1			0.1	0.1	0.4		0.1	
FCC Gasoline:	25.1	43.4	43.3	28.5	19.3	58.7	59.8	26.7	19.9	58.7	61.2	27.3	26.4	21.8	42.7	28.2	
Full Range	11.9	17.1	12.6	12.3	5.7	38.6	30.7	10.7	4.0	38.6	38.7	10.4	14.2		24.6	14.7	
Light	0.7	0.7	10.1	1.9				12.0	1.5			12.5	1.6	0.1	2.9	6.4	1.0
Light - Desulf.					8.8	1.1	0.9		3.3	1.1	1.7		1.4			9.4	1.2
Medium	3.6	5.2	8.8	4.4	4.3			3.3	3.9	4.4		2.0	3.9	3.7	7.8	2.3	3.8
Medium - Desulf.	5.7	11.1		5.3	6.4	12.2			5.9	6.5	12.1		6.0	4.9			4.0
Heavy					0.4	0.1								0.7			0.6
Heavy - Desulf.	3.1	9.3	2.6	3.4	2.1	8.0	10.5	3.5	3.3	8.0	8.0	4.1	2.7	11.1		2.8	
Reformate	23.3	3.9	40.3	24.5	25.9	1.5	31.8	25.3	26.7	2.0	29.7	25.7	21.7	14.0	40.1	23.7	
Light	9.9		10.6	9.4	8.2	1.5	31.8	10.9	7.0	2.0	29.7	9.6	12.0		8.7	10.9	
Medium																	
Heavy	13.5	3.9	29.7	15.0	17.6			14.4	19.7			16.1	9.8	14.0	31.3	12.8	
Oxygenate	7.8	7.8	0.0	6.8	7.8	7.8	0.0	6.8	7.8	7.8	0.0	6.8	7.8	7.8	0.0	6.8	
MTBE																	
Ethanol	7.8	7.8		6.8	7.8	7.8		6.8	7.8	7.8		6.8	7.8	7.8		6.8	
TBA																	
ETBE																	
TAME																	
DIPE																	
Volume (K Bbl/day)	1,022	68	161	1,251	1,022	68	161	1,251	1,022	68	161	1,251	1,022	68	161	1,251	

Exhibit 5: Gasoline Composition and Volume

Gasoline Composition & Volume	Phase 3 PM											
	No Oxygenate											
	RF A				RF B Delta ARB				RF C Delta ARB			
	Case 1d				Case 2d				Case 3d			
	CARB	Ariz.	Conv.	Pool	CARB	Ariz.	Conv.	Pool	CARB	Ariz.	Conv.	Pool
Composition (vol%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
C4s:	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Butenes	0.5	0.5		0.4								
I-Butane												
N-Butane			0.5	0.1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
C5s & Isomerate	12.6	5.4	2.6	10.7	13.0			2.6	10.7	12.4		2.0
Raffinate												
Natural Gas Liquids												
Naphtha	0.0	0.0	4.5	0.7	0.3	0.0	4.8	0.9	1.2	0.0	4.7	1.6
C5-160			4.5	0.7	0.3		4.8	0.9	1.2		4.7	1.6
Coker Naphtha												
160-250												
Alkylate	26.4	18.2	5.2	22.8	26.6	25.0	4.9	23.3	24.5	22.8	7.0	22.0
Hydrocrackate	9.3	10.6		8.0	9.1	15.8		8.2	8.5	21.0	0.5	8.1
Dimate												
Poly Gasoline	0.7			0.5	0.7			0.5	0.7			0.5
FCC Gasoline:	22.8	47.8	51.7	28.6	21.1	49.2	52.2	27.4	22.4	40.7	51.5	27.5
Full Range					3.3	9.9		3.2	6.5		4.0	5.7
Light	3.2	4.1	17.8	5.4	1.6	4.1	19.0	4.3	0.7	3.5	18.4	3.4
Light - Desulf.			1.4	0.2							1.0	0.1
Medium	11.8	6.8	16.3	12.2	8.7	5.7	16.4	9.7	7.3	6.1	14.6	8.2
Medum - Desulf.	3.5	23.7	3.6	4.8	4.6	15.5	3.6	5.1	5.2	14.6	2.0	5.3
Heavy			4.3	0.6			4.1	0.6	0.1		11.6	1.7
Heavy - Desulf.	4.2	13.2	8.4	5.4	2.9	14.1	9.0	4.5	2.5	16.5		3.0
Reformate	27.7	9.7	35.4	27.7	28.7	1.8	35.1	28.0	29.9	7.2	33.8	29.1
Light	18.3	9.7	10.7	16.7	19.3	1.8	9.9	16.9	18.2	7.2	9.5	16.3
Medium			24.7	3.6			25.1	3.7			24.2	3.4
Heavy	9.4			7.4	9.4			7.4	11.7			9.4
Oxygenate	0.0	7.8	0.0	0.5	0.0	7.8	0.0	0.5	0.0	7.8	0.0	0.5
MTBE												
Ethanol		7.8		0.5		7.8		0.5		7.8		0.5
TBA												
ETBE												
TAME												
DIPE												
Volume (K Bbl/day)	872	68	161	1,101	872	68	161	1,101	922	68	161	1,151

Exhibit 5: Gasoline Composition and Volume

Gasoline Composition & Volume	Feinstein-Bilbray Ethanol (2.7 wt%)/No Oxygenate											
	RF A				RF B Delta ARB				RF C Delta ARB			
	Case 1e				Case 2e				Case 3e			
	CARBeoh	CARBno	Az.&Cv.	Pool	CARBeoh	CARBno	Az.&Cv.	Pool	CARBeoh	CARBno	Az.&Cv.	Pool
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Composition (vol%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
C4s:	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Butenes												
I-Butane												
N-Butane	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
C5s & Isomerate	5.8	10.3	6.2	7.3	2.7	15.4	6.3	7.4	4.2	11.9	7.8	7.3
Raffinate												
Natural Gas Liquids												
Naphtha	2.5	0.0	3.4	1.9	0.0	3.9	3.4	1.9	0.0	3.9	3.4	1.9
C5-160	2.5		3.4	1.9		3.9	3.4	1.9		3.9	3.4	1.9
Coker Naphtha												
160-250												
Alkylate	12.6	37.2	11.4	20.3	17.3	34.3	10.1	21.4	16.2	31.4	9.5	19.9
Hydrocrackate	17.3	8.9	1.2	11.6	23.3			11.6	24.0	0.0	0.0	11.9
Dimate												
Poly Gasoline	0.6			0.3	0.0	0.6		0.2		0.6		0.2
FCC Gasoline:	16.4	34.1	52.9	28.7	14.5	31.3	56.0	27.4	12.6	35.5	55.5	27.8
Full Range	3.9	21.2	38.2	15.7	2.9	24.5	31.0	15.0	1.7	27.7	28.1	14.8
Light	1.4	2.0	2.4	1.8	0.4	1.3	2.1	1.0	1.9	0.4	2.0	1.4
Light - Desulf.			6.0	1.1			6.6	1.2			6.6	1.2
Medium	3.1	5.4	1.4	3.5	2.1	3.0	5.8	3.1		5.5	7.5	3.1
Medium - Desulf.	7.9			3.9	9.0			4.5	9.0			4.5
Heavy			1.9	0.3			1.7	0.3			1.5	0.3
Heavy - Desulf.		5.4	3.1	2.3		2.4	8.7	2.4		2.0	9.8	2.4
Reformate	36.7	9.1	22.0	25.2	34.0	14.1	21.4	25.3	34.8	16.3	20.9	26.3
Light	13.0	6.0	14.5	11.0	11.0	5.2	21.1	11.0	8.9	8.0	20.9	10.8
Medium												
Heavy	23.7	3.1	7.5	14.2	23.0	8.8	0.3	14.3	25.9	8.3		15.5
Oxygenate	7.8	0.0	2.3	4.3	7.8	0.0	2.3	4.3	7.8	0.0	2.3	4.3
MTBE												
Ethanol	7.8		2.3	4.3	7.8		2.3	4.3	7.8		2.3	4.3
TBA												
ETBE												
TAME												
DIPE												
Volume (K Bbl/day)	622	400	229	1,251	622	400	229	1,251	622	400	229	1,251

Exhibit 6: Estimated Costs of California Phase 3 RFG, by Case

Measure	Phase 3 PM						PM-2
	MTBE	Ethanol (2.0 wt%)					
		RFA	RFA	RFB Delta ARB	RFC Delta ARB	RFD Delta ARB	RFA Delta ARB
	Base 2	Case 1a	Case 2a	Case 3a	Case 4a	Case 4a	Sup 1a
COSTS							
Total Average Cost (¢/gal.)	-0.1	5.5	6.4	5.2	5.7	5.0	
Variable Cost	0.0	4.2	4.6	3.8	4.2	3.9	
Refinery Capital Charge	0.0	0.7	1.1	0.8	0.9	0.4	
Ancillary Refining Cost		0.3	0.3	0.3	0.3	0.3	
Logistics Cost		0.1	0.1	0.1	0.1	0.1	
Mileage Loss	-0.1	0.2	0.4	0.2	0.3	0.4	
Total Seasonal Cost (\$ million)	-10	430	510	410	450	390	
Variable Cost	0	330	360	300	330	300	
Refinery Capital Charge	0	50	90	60	70	30	
Ancillary Refining Cost		20	20	20	20	20	
Logistics Cost		10	10	10	10	10	
Mileage Loss	-10	20	30	20	20	30	
Refinery Investment (\$million)	1	350	560	410	440	190	
IMPORTS/EXPORTS (K bbl/d)							
Oxygenates	107	63	63	63	63	63	63
MTBE	107						
Ethanol		63	63	63	63	63	
Other Imports	11	125	136	111	121	125	
Isobutane			5				1
Isomerate		13	19		10	12	
Alkylate	11	111	111	111	111	111	
CARBOB							
Jet Fuel & EPA Diesel							
Rejected Blendstocks	0	47	49	39	49	34	
Mixed Butylenes		5	1	5	5	4	
Pentanes		28	27	9	18	16	
Light Coker Naphtha							
Light FCC Gasoline		13	20	25	25	14	
Heavy FCC Gasoline							
Naphtha (250 - 325 °F)							
Heavy Reformate							
CAPACITY UTILIZATION (%)							
Crude Distillation	98	99	99	99	99	99	
Conversion	97	97	98	97	98	97	
Upgrading	85	90	93	91	91	89	

Exhibit 6: Estimated Costs of California Phase 3 RFG, by Case

Measure	Phase 3 PM				PM-2		Phase 3 PM			
	Ethanol (2.7 wt%)				No Oxygenate					
	RF A	RF B	RF C	RF A	RF A	RF B	RF C	Delta ARB		
	Case 1b	Case 2b	Case 3b	Sup 1b	Case 1d	Case 2d	Case 3d	Delta ARB		
COSTS										
Total Average Cost (¢/gal.)	3.8	5.0	4.3	4.4	4.9	5.2	3.4			
Variable Cost	2.1	3.1	2.7	2.9	3.9	3.9	2.9			
Refinery Capital Charge	0.8	0.7	0.7	0.3	1.6	1.7	1.1			
Ancillary Refining Cost	0.3	0.3	0.3	0.3	0.3	0.3	0.3			
Logistics Cost	0.1	0.1	0.1	0.1						
Mileage Loss	0.6	0.7	0.6	0.7	-0.9	-0.8	-0.9			
Total Seasonal Cost (\$ million)	300	400	340	350	370	410	270			
Variable Cost	160	250	220	230	300	310	230			
Refinery Capital Charge	60	60	50	30	120	140	90			
Ancillary Refining Cost	20	20	20	20	20	20	20			
Logistics Cost	10	10	10	10						
Mileage Loss	50	60	40	60	-70	-60	-70			
Refinery Investment (\$million)	390	370	350	170	820	900	590			
IMPORTS/EXPORTS (K bbl/d)										
Oxygenates	85	85	85	85	5	5	5			
MTBE										
Ethanol	85	85	85	85	5	5	5			
Other Imports	49	67	58	78	273	273	223			
Isobutane					12	12	1			
Isomerate					30	30	30			
Alkylate	49	67	58	78	81	81	91			
CARBOB					150	150	100			
Jet Fuel & EPA Diesel										
Rejected Blendstocks	16	22	15	13	48	52	27			
Mixed Butylenes	4	5	6	7	8	13	4			
Pentanes	1	2	5	3	13	9	1			
Light Coker Naphtha										
Light FCC Gasoline	11	15	4	3	11	15	22			
Heavy FCC Gasoline										
Naphtha (250 - 325 °F)										
Heavy Reformate					16	15				
CAPACITY UTILIZATION (%)										
Crude Distillation	99	100	100	97	94	94	96			
Conversion	98	98	98	96	93	94	95			
Upgrading	92	93	93	87	99	101	100			

Exhibit 6: Estimated Costs of California Phase 3 RFG, by Case

Measure	Feinstein-Bilbray		
	Ethanol (2.7 wt%)/No Oxygenate		
	RF A	RF B Delta ARB	RF C Delta ARB
	Case 1e	Case 2e	Case 3e
COSTS			
Total Average Cost (¢/gal.)	2.9	3.4	2.6
Variable Cost	1.7	2.3	1.7
Refinery Capital Charge	0.6	0.7	0.7
Ancillary Refining Cost	0.3	0.3	0.3
Logistics Cost	0.1	0.1	0.1
Mileage Loss	0.1	0.0	-0.2
Total Seasonal Cost (\$ million)			
Variable Cost	130	180	130
Refinery Capital Charge	50	60	50
Ancillary Refining Cost	20	20	20
Logistics Cost	10	10	10
Mileage Loss	10	0	-10
Refinery Investment (\$million)	330	370	340
IMPORTS/EXPORTS (K bbl/d)			
Oxygenates	54	54	54
MTBE			
Ethanol	54	54	54
Other Imports	99	116	93
Isobutane			
Isomerate	5	5	3
Alkylate	95	111	89
CARBOB			
Jet Fuel & EPA Diesel			
Rejected Blendstocks	6	14	7
Mixed Butylenes	6	7	5
Pentanes	0	2	2
Light Coker Naphtha			
Light FCC Gasoline		6	
Heavy FCC Gasoline			
Naphtha (250 - 325 °F)			
Heavy Reformate			
CAPACITY UTILIZATION (%)			
Crude Distillation	100	100	100
Conversion	98	98	98
Upgrading	95	95	97

Exhibit 7: Estimated Effects of the Feinstein-Bilbray Bill

Non-Oxygenated CARB Gasoline	Case 1E (Reference Fuel A)						
	0	100	200	300	400	500	600
	Volume (K bbl/d) -->	0.0%	9.8%	19.6%	29.4%	39.1%	48.9%
% of CARB Pool -->	0.0%	9.8%	19.6%	29.4%	39.1%	48.9%	58.7%
Cost Savings (¢/gal)		0.2	0.3	0.4	0.9	0.9	1.1
Refining Costs	-	0.0	0.0	0.0	0.5	0.2	0.3
Mileage Improvement	-	0.1	0.3	0.4	0.5	0.7	0.8
Reduction in Refinery Investment (\$MM)	-	-20	70	80	60	70	-50
Imports (K bbl/d)	134	127	134	141	153	157	159
Ethanol	85	77	69	61	54	46	38
Isobutane							
Isomerate				0	5	2	10
Alkylate	49	50	65	80	94	109	111
CARBOB							
Jet Fuel & EPA Diesel							
Rejected Blendstocks (K bbl/d)	17	14	11	7	6	6	9
Mixed Butylenes	5	6	5	6	6	6	6
Pentanes	0	3	1	1	0	0	2
Light Coker Naphtha							
Light FCC Gasoline	12	5	5				0
Heavy FCC Gasoline							
Naphtha (250 - 325 °F)							
Heavy Reformate							

Note: Cost savings and reduction in refinery investment are calculated relative to the
zero non-oxygenated gasoline case (i.e., 100% ethanol blending at 2.7 wt% oxygen)

Exhibit 7: Estimated Effects of the Feinstein-Bilbray Bill

Non-Oxygenated CARB Gasoline	Case 2E (Reference Fuel B)						
	0	100	200	300	400	500	600
	Volume (K bbl/d) -->	0.0%	9.8%	19.6%	29.4%	39.1%	48.9%
% of CARB Pool -->	0.0%	9.8%	19.6%	29.4%	39.1%	48.9%	58.7%
Cost Savings (¢/gal)		0.4	0.7	0.9	1.6	1.5	1.7
Refining Costs	-	0.2	0.3	0.3	0.9	0.6	0.6
Mileage Improvement	-	0.2	0.4	0.6	0.8	0.9	1.0
Reduction in Refinery Investment (\$MM)	-	-50	-20	20	0	-120	-210
Imports (K bbl/d)	160	152	152	161	167	167	170
Ethanol	85	77	69	61	54	46	38
Isobutane							
Isomerate			0		2	10	21
Alkylate	76	76	83	99	111	111	111
CARBOB							
Jet Fuel & EPA Diesel							
Rejected Blendstocks (K bbl/d)	19	16	14	12	12	17	23
Mixed Butylenes	6	6	6	7	7	6	6
Pentanes	4	4	5	5	1	2	3
Light Coker Naphtha							
Light FCC Gasoline	10	6	3		4	9	14
Heavy FCC Gasoline							
Naphtha (250 - 325 °F)							
Heavy Reformate							

Note: Cost savings and reduction in refinery investment are calculated relative to the
zero non-oxygenated gasoline case (i.e., 100% ethanol blending at 2.7 wt% oxygen)

Exhibit 7: Estimated Effects of the Feinstein-Bilbray Bill

Non-Oxygenated CARB Gasoline	Case 3E (Reference Fuel C)						
	0	100	200	300	400	500	600
	Volume (K bbl/d) -->	0.0%	9.8%	19.6%	29.4%	39.1%	48.9%
% of CARB Pool -->	0.0%	9.8%	19.6%	29.4%	39.1%	48.9%	58.7%
Cost Savings (¢/gal)		0.4	0.8	1.0	1.8	1.7	2.0
Refining Costs	-	0.2	0.3	0.4	1.0	0.9	1.0
Mileage Improvement	-	0.3	0.4	0.6	0.7	0.8	1.0
Reduction in Refinery Investment (\$MM)	-	10	-10	-10	10	50	20
Imports (K bbl/d)	144	142	138	140	145	159	163
Ethanol	85	77	69	61	54	46	38
Isobutane							
Isomerate			2		2	8	14
Alkylate	59	65	68	78	90	106	111
CARBOB							
Jet Fuel & EPA Diesel							
Rejected Blendstocks (K bbl/d)	15	15	15	8	7	6	8
Mixed Butylenes	6	6	5	5	5	6	6
Pentanes	5	5	4	3	2	0	1
Light Coker Naphtha							
Light FCC Gasoline	4	5	6				
Heavy FCC Gasoline							
Naphtha (250 - 325 °F)							
Heavy Reformate							

Note: Cost savings and reduction in refinery investment are calculated relative to the
zero non-oxygenated gasoline case (i.e., 100% ethanol blending at 2.7 wt% oxygen)